

CHAPTER 11

LAND SUBSIDENCE

Land subsidence is defined as the sinking of the land over manmade or natural underground voids. Subsidence occurs naturally and also through man-driven or technologically exacerbated circumstances. Natural causes of subsidence occur when water in the ground dissolves minerals and other materials in the earth, creating pockets or voids. When the void can no longer support the weight of the earth above it, it collapses, causing a sinkhole depression in the landscape. Often, natural subsidence is associated with limestone erosion but may also occur with other water-soluble minerals.

A layer of prehistoric rock known as the Triassic Spearfish Formation traverses Crook County. The formation is abundant with gypsum, a soluble mineral that dissolves as water infiltrates the ground. As the gypsum dissolves, caves form underground. Sinkholes appear on the ground surface when the roof of an underground cave collapses. This type of landscape is referred to as “karst,” identified by the dissolution of layers of soluble minerals and bedrock. Karst landscapes may be marked by caves, sinkholes, cenotes, and other surface features. Figure 11.1 depicts known locations of gypsum-bearing strata in the State. Note the abundance of gypsum in Crook County (circled in blue).

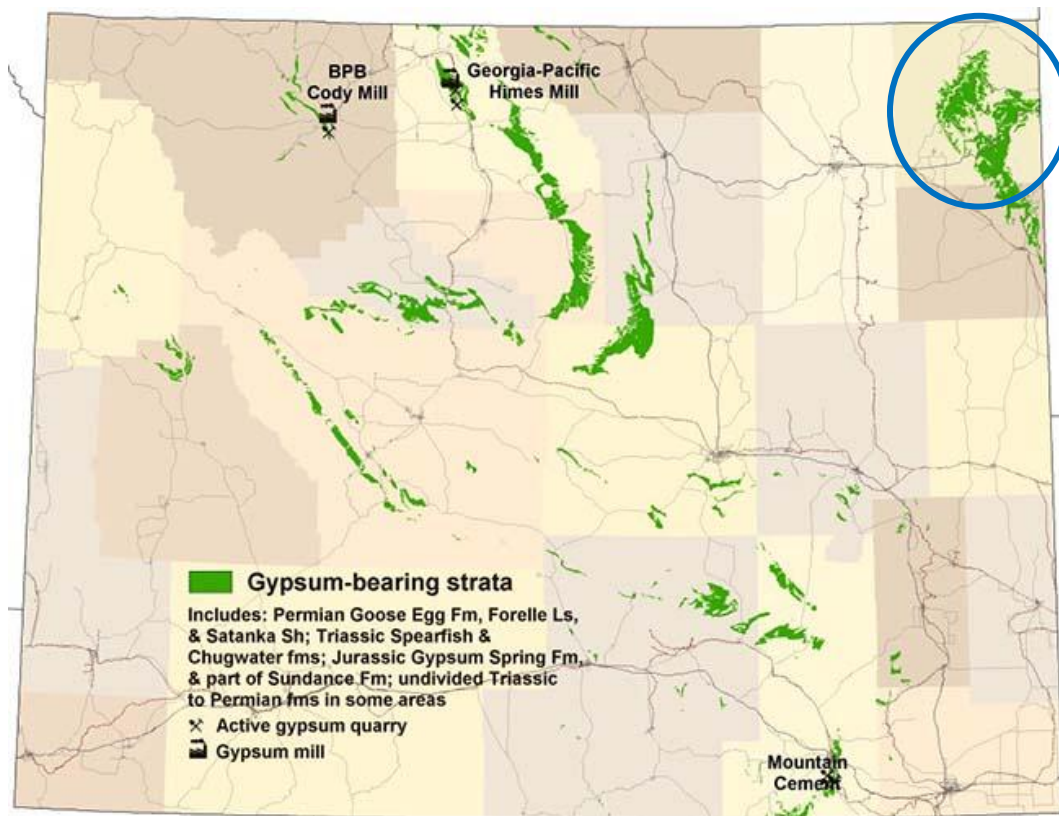


Figure 11.1 Gypsum-bearing strata in Wyoming

Source: Wyoming State Geological Survey, “Gypsum,” accessed December 13, 2012.

Subsidence can also occur as a result of human-caused activities. Man-driven or technology-exacerbated subsidence conditions are associated with the lowering of water tables, extraction of natural gas, or subsurface mining activities. As the underground voids caused by these activities settle or collapse, subsidence occurs on the surface.

Underground coal mining began in Wyoming during the 1860s. Many of the early coal mines were not designed and constructed well; as a result the underground pillars failed. If enough support pillars failed, the caprock in the mine would collapse, and the effects of the collapse would reach the surface in some cases. If the effects of the collapse reached the surface, a subsidence pit would form. Not all subsidence was due to poor design, however. In some cases, the pillars were pulled as mining retreated from an area. In other cases, fires would occur in the mines, resulting in a loss of strength in the pillars and caprock.

History

Many natural sinkholes are located along the proposed Bakken Pipeline route from Aladdin to the Inyan Kara Mountain area. The scientist who conducted the “Geologic Factors for the Proposed Bakken Pipeline Route in Portions of Crook and Weston County, Wyoming” report photographed several sinkholes on ranches around the proposed pipeline route. Some sinkholes were roughly ten years old, but others had occurred as recently as spring 2012. The report did not provide dollar values for property damage or state whether the sinkholes caused injury to people or animals.

Crook County has not experienced significant subsidence problems related to abandoned mines, although there are a few abandoned mine locations in the County as depicted in Figure 11.2. According to Figure 11.2 there are three known mined-out areas in Crook County, but no known subsidence issues are associated with those locations.

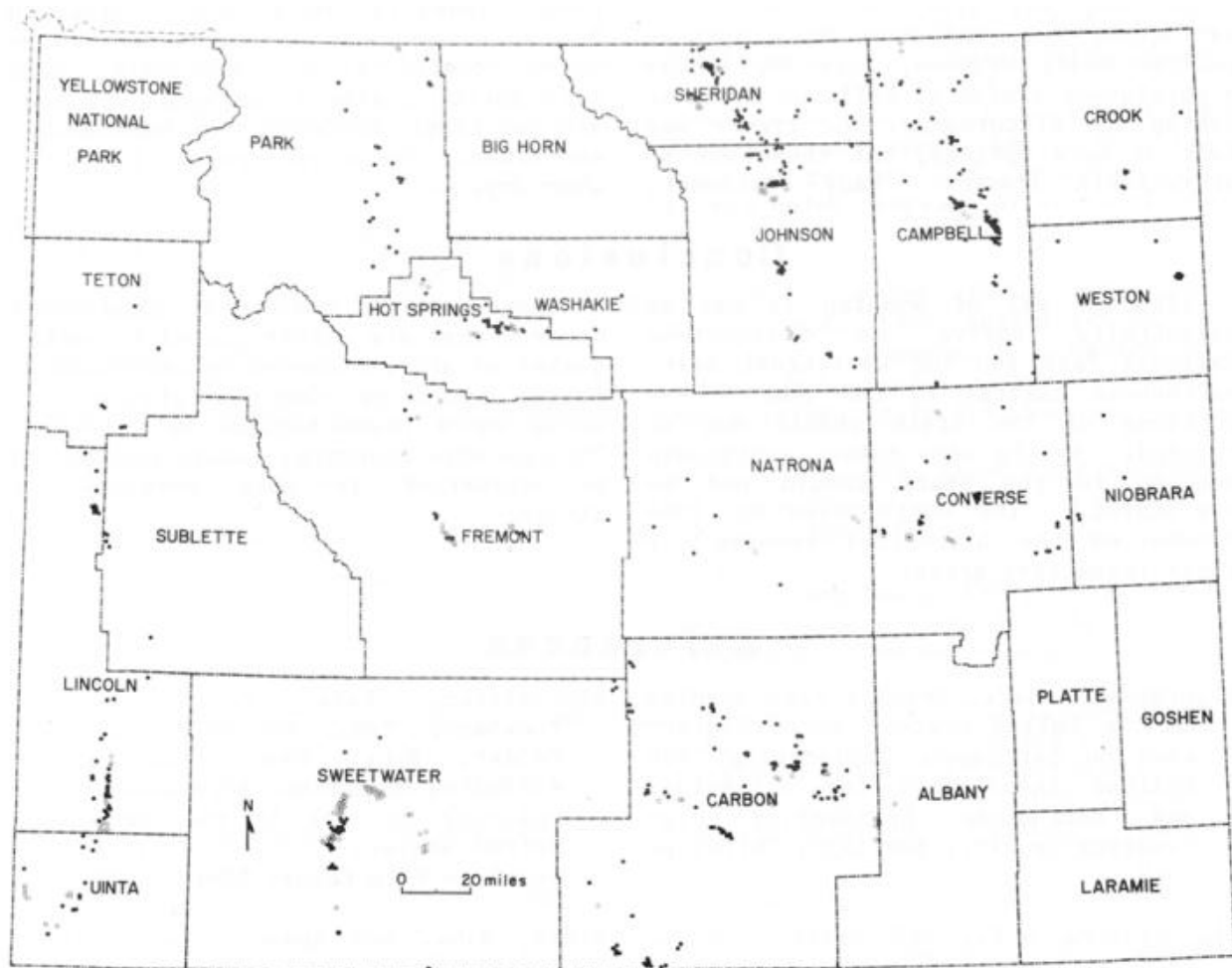


Figure 11.2 – Mined-out areas and mine subsidence in Wyoming. Gray areas represent mined-out areas with subsidence. Solid areas represent mined-out areas with no known subsidence.

Impacts

The greatest dangers associated with subsidence are related to property damages incurred by the hazard. Underground utility lines and pipes can also be damaged by sinkholes and subsidence. Figure 11.3 depicts a sinkhole on the Watson Ranch in Crook County. An exposed cable leading to an abandoned missile site is visible in the photograph.

According to the 2011 Wyoming Multi-Hazard Mitigation Plan, there has been property and infrastructure damage associated with coal-mine subsidence in Wyoming communities. The dollar amounts of the damage are not readily available. An indirect measure of the impacts is the existing cost of mitigating the hazards. The Wyoming Abandoned Mine Lands (AML) Program at Wyoming Department of Environmental Quality (DEQ) spent \$85 million through 2007 mitigating the effects of mine subsidence and on mine reclamation. Additionally, the AML makes subsidence insurance available to property owners in affected communities. County-level data was not provided in the State Plan.

There are minimal risks to injury and death from unexpected subsidence or accidental exposure to it, but nevertheless the risk is possible. Animals such as cows and horses could be injured by unexpected subsidence. The risk to animals is relevant to the planning area given the presence of sinkholes on ranches in parts of Crook County.



Figure 11.3 Sinkhole near Watson Ranch

Source: Perry H. Rahn, “Geologic Factors for the Proposed Bakken Pipeline Route in Portions of Crook and Weston Counties, Wyoming,” April 4, 2012.

Future Impacts

Although many areas in Wyoming have already had mitigation projects designed to reduce or remove the impacts from underground mining and subsidence, subsidence may still occur in some areas. The dollar impact is difficult to predict.

Although past subsidence impacts have been minimal, Crook County should continue to make efforts to study geologic hazards as they relate to future industry and development to avoid future problems. A study was conducted to evaluate the presence of geologic hazards along the proposed Bakken Pipeline route in Crook and Weston counties. The report, published April 4,

2012, determined that the abundance of soluble gypsum beneath the proposed pipeline route could compromise the project. If the pipeline were damaged by a sinkhole, natural gas or liquid petroleum could seep out. Liquid petroleum leaking out of the pipeline could contaminate local ground water. Subsidence issues could seriously compromise the Bakken Pipeline project and other development initiatives that are undertaken without a thorough geologic hazard study.

Summary

PROPERTY AFFECTED: Low

POPULATION AFFECTED: Low

PROBABILITY: High

JURISDICTION AFFECTED: County